

Mercury Sources, Transport, and Fate in the Atmosphere

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As a chemical element, mercury is ubiquitous in the human environment. Human activity over the last 200 years has made additional amounts of mercury available for cycling through the atmosphere and aquatic and marine environments. Sources of mercury released to the atmosphere currently fall into two broad categories, anthropogenic and background. Because of the complex interactions among geophysical, biological, and chemical environments that contribute to the cycling of mercury, there are no benign tracer substances that can be used to follow mercury from source to ultimate fate, including human exposure. Consequently, we must rely on computer models (although emerging stable isotope methods may eventually allow discrimination of mercury by source category). The models used are essentially limited by the dearth of wide-ranging data on mercury in many specific environments.

An expert panel found in spring 2000 that limitations on mercury source-receptor relationships could be resolved only by extensive increases in observational data. The associated uncertainties in mercury assessments are slowly being reduced as models improve and are correlated with increasing sets of observation in validation checks. Recent model results have evaluated both total mercury deposition nationally, from all sources global and domestic, and deposition due to source categories of interest, including coal-fired utilities. But remaining uncertainties remain large enough to accommodate significantly revised estimates of some poorly-characterized source terms. For example, a recent study by the Geological Survey of Canada estimated background emissions of mercury at least twice the generally accepted levels needed for mass balance. But measurements in spring 2002 in the mid-latitude tropopause indicate a possibly enhanced removal mechanism of uncertain chemistry that may accommodate increased background emissions of just that magnitude.

Within these uncertainties, we are now able to undertake scenario evaluation to assess the changes in deposition that might occur under various management scenarios that might occur.